Non-CO_2 Greenhouse Gases: Methane

Source/Sectors: Natural Gas Systems (Production; Processing; Transmission)

Technology: Installation of electric starters on compressors (A.1.2.1.11; A.1.2.3.9)

Description of the Technology:
In the United States and worldwide, many efforts have been made to identify and implement mitigation options to reduce methane emissions from the natural gas sector (USEPA, 2003). For example, the Natural Gas STAR program is a voluntary partnership between US EPA and the oil and gas industry to identify and implement cost-effective technologies and measures to reduce methane emissions. The measures to reduce methane emissions from the natural gas systems can be grouped into the following mitigation strategies: prevention, recovery and re-injection, recovery and utilization, and recovery and incineration (Hendriks & de Jager, 2001).

Small gas expansion turbine motors are often used to start internal combustion engines for compressors, generators, and pumps in natural gas production. These starters use compressed natural gas to provide the initial push to start the engine, but use of them results in methane emissions (USEPA, 2004a; IEA, 2003). Partners of the Natural Gas Star Program have found that replacing the starter expansion turbine with an electric motor starter, similar to an automobile engine starter, can avoid methane emissions. The technology may include a connection to utility electrical power, site generated power, or solar recharged batteries (USEPA, 2008).

Effectiveness: Good

Implementability: This technology is applicable in all sectors of the gas industry.

Reliability: Good

Maturity: Good

Environmental Benefits: Conversion to electric starters completely eliminates the venting and the leakage of methane through the gas shutoff valve. Partners have reported savings of 23 Mcf to 600 Mcf per year, a range that is dependent on how many times compressors are restarted in a year and how readily the engine starts up and stays running. A single startup of a properly tuned engine may require 1 Mcf to 5 Mcf of gas at 200 psig average volume tank pressure, depending on engine size (horsepower). Blowdown valves of a size and pressure differential similar to the gas shutoff valve leak up to 150 scf per hour or 1.3 MMcf per year (USEPA, 2008).

Cost Effectiveness: Methane emissions savings of 1,350 Mcf per year apply to one engine starter, ten startups per year and methane leakage through the gas shutoff valve. This technology can provide a payback in less than three years. Important economic considerations include the capital cost of installing an electric starter motor, the revenue gained from salvaging the gas expansion turbine starter, and the cost of the electric power needed to drive the motor. The electrical energy required for the new starter will be equivalent to the energy imparted by the gas expansion. Using an electrical power cost of 7.5¢ per kWh, the gas expansion turbine above is equivalent to $1 to $5 per engine start attempt, depending on engine size (horsepower) (USEPA, 2008).

- Capital Costs (including installation): $1,000 - $10,000
- Operating and Maintenance Costs (annual) : <$100

- Payback (Years): 1-3

Technology	**Lifetime (yrs)**	**MP (%)**	**RE (%)**	**TA (%)**	**Capital cost**	**Annual cost**	**Benefits**
Installation of electric starters on compressors[1]	10	-	75	<0.5	$838.62	$2,096	$6.82

Note: MP: market penetration; RE: reduction efficiency; TA: technical applicability; costs are in year 2000 US$/MT$_{CO2\text{-}Eq.}$

1: IEA (2003) & USEPA (2004)

Industry Acceptance Level: Fair

Limitations: Electric starters require a power supply. Power can be provided from electrical utility, portable and solar-recharged batteries, or generated onsite (USEPA, 2008).

Sources of Information:

1. California Energy Commission (2005) "Emission Reduction Opportunities for Non-CO_2 Greenhouse Gases in California", a report prepared by ICF Consulting for California Energy Commissions, CEC-500-2005-121, July 2005.
2. Hendriks, C.; de Jager, D. (2001) "Economic Evaluation of Methane Emission Reductions in the Extraction, Transport and Distribution of Fossil Fuels in the EU: Bottom-up Analysis", A final report to European Commission.
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4. U.S. Climate Change Technology Program (2005) "Technology Options for the Near and Long Term", U.S. Department of Energy, http://www.climatetechnology.gov/index.htm, August 2005.
5. U.S. Environmental Protection Agency (2003) "International Analysis of Methane and Nitrous Oxide Abatement Opportunities: Report to Energy Modeling Forum, Working Group 21", a report prepared by ICF Consulting for the United States Environmental Protection Agency.
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7. U.S. Environmental Protection Agency (2004b) "Convert Engine Starting to Nitrogen", PRO Fact Sheet No. 101,http://www.epa.gov/gasstar/pdf/pro_pdfs_eng/convertenginestartingtonitrogen.pdf, Natural Gas Star Program, U.S. EPA, Washington DC, 2004.
8. U.S. Environmental Protection Agency (2008), Natural Gas Star Program, http://www.epa.gov/gasstar/index.htm, U.S. EPA, Washington DC, 2004.